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PENNSYLVANIA DEPARTMENT OF AGRICULTURE
BUREAU OF ECONOMIC ZOOLOGY

CIRCULAR No. 1

NEW SERIES

HARRISBURG, PA.,

MARCH 15, 1917

OFFICIAL QUARANTINE NOTICE.

Prohibiting the Shipment of 5-leaved Pine Trees Into Pennsylvania.

THE WHITE PINE BLISTER DISEASE.

The existence and the wide-spread occurrence and establishment of the dangerous imported white pine blister disease (*Cronartium ribicola* Dietr.) in the New England States, and local outbreaks in several other states, are deemed sufficient reasons for declaring a quarantine, whereby the common white pine and other five-needle ornamental pines in Pennsylvania may be protected, by prohibiting the shipment into this Commonwealth from outside sources of any pine susceptible to this disease.

"PENNSYLVANIA DEPARTMENT OF AGRICULTURE

Bureau of Economic Zoology

Harrisburg

By virtue of authority conferred by "an act to provide for the protection of trees, shrubs, vines and plants against destructive insects and diseases, etc.," approved the 31st day of March, A. D., 1905, the shipment into the Commonwealth of Pennsylvania from any outside source of any living white pine or other five-leaved pine trees of any age, for planting or propagation, is hereby prohibited until further notice. Violations of this order will be dealt with according to the provisions of the aforementioned act.

Dated March 12, 1917.

J. G. SANDERS,
Economic Zoologist."

CHARLES E. PATTON,
Secretary of Agriculture.

THE DISEASE.

Present Status. Another unwelcome plant pest from abroad has been introduced to America on diseased pine seedlings, and has become established quite generally in all the New England States, is widely scattered in New York and locally established in several other points as far west as Wisconsin and Minnesota. Having been found in limited amounts at only six points in Pennsylvania, we hope to stamp out the disease if rigid inspection and care will accomplish its control.

Peculiar Habits. Although a native parasite of the stone pine (*Pinus cembra*) in Europe, this disease attacks the American white pine (*P. strobus*) with greater severity, and rapidly produces cankers which girdle the growth and kill the tree or branches above the point of attack. Diseased trees, after a period of incubation, produce blisters on the young bark, which burst, liberating millions of tiny dust-like spores. These spores are carried by wind and other means to the leaves of wild and cultivated currants and gooseberries, where they produce a rust red fungus, which in turn fruits within two weeks and infects other currants and gooseberries in the vicinity.

In midsummer and autumn another brown spore stage is formed, which infects the new growth of pines close at hand. After this infection, two to five years may elapse before the pine exhibits external indication of the disease.

It is impossible for a pine bearing the fruiting stage of the disease to affect another pine without the intermediate stages on currants and gooseberries. For this reason control measures are possible where the disease is discovered, and entail the destruction of the diseased pines and infected currants or gooseberries in the vicinity.

It is impossible to inspect trees absolutely for this disease and determine with absolute certainty their freedom from infection. It is therefore deemed advisable to place this quarantine, in order that the white pine and other five-leaved ornamental pines in Pennsylvania may not be exposed to further danger.

A list of species of five-leaved pines which may become infected with the pine blister disease:

American species.—*Pinus albicaulis*; *P. flexilis*; *P. monticola*; *P. strobiformis*; *P. strobus*; *P. lambertiana*; *P. aristata*; *P. balfouriana*; *P. ayacahuite*.

European and Asiatic species.—*Pinus cembra*; *P. excelsa*; *P. peuce*; *P. parviflora*; *P. pentaphylla*; *P. pumila*; *P. coraiensis*; *P. armandii*; *P. scipioniformis*.

J. G. SANDERS,
Economic Zoologist.

Approved March 12, 1917.
CHARLES E. PATTON,
Secretary of Agriculture.

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PENNSYLVANIA DEPARTMENT OF AGRICULTURE
BUREAU OF ECONOMIC ZOOLOGY
CIRCULAR No. 2
NEW SERIES

HARRISBURG, PA.,

JUNE 20, 1917

TREE SERMONETTES.

CONCISE INFORMATION ON THE CARE OF TREES.

By J. G. SANDERS, Economic Zoologist.

This circular presents in tabloid form some brief and necessarily incomplete information on the planting and care of shade and ornamental trees and shrubs, in the form as prepared for the daily papers of the Commonwealth, and released for publication on April 6th and April 12th, 1917.

Under the heading "Tree Sermonettes" as originally prepared, these twelve short essays printed in the "Weekly Press Bulletin" of this Department are reproduced to meet a demand for the information contained in them.

No. 1. TREES FOR SHADE AND ORNAMENT.

Plant useful, long-lived trees for yourselves and for coming generations. Give them sensible care and protection from animals and pests. Beautiful and well-placed trees add incalculable values to homes and cities, furnishing cool, refreshing shade during the hot summer days. No landscape is complete without them; they relieve monotony, add beauty and grace to our scenes, and instill a love of nature.

No. 2. TREES FOR PLANTING.

Short lived trees, such as poplar, willow, box elder and soft maple should never be planted for permanence. Choose Norway and hard maple, elm, oak, hickory, sycamore, hackberry and linden. The imported poplar weevil which seriously injures willow and poplar cannot be controlled. Our beautiful Lombardy poplars may be doomed since the recent introduction from Europe of the new poplar canker disease which injures poplars much like the chestnut blight ruins chestnut.

No. 3. EVERGREEN TREES DESIRABLE.

The beautiful evergreen spruces, pines and arbor vitae can be used with telling effect in landscape plans. In group plantings, for hedges and as screens for unsightly buildings, evergreens excel. White pine and certain other ornamental pines with leaves in bundles of five are subject to the new imported pine blister canker which is sweeping the New England States and has been discovered at a few points in Pennsylvania. Do not plant these species at this time. As windbreaks, double or triple rows of evergreens are most desirable.

No. 4. PLANTING DIRECTIONS.

Space large growing trees not less than forty feet. Dig large holes to amply admit the roots, keeping top soil separate to pack tightly about the roots. Fertilize with well-rotted manure and water occasionally. Prune off and thin out about three-fourths of the top of deciduous trees when planting. Never prune or thin out an evergreen tree but keep roots thoroughly moist when transplanting. Protect street trees from horses by metal or wooden guards.

No. 5. PRUNING AND TRIMMING.

Trees have individual types of growth; prune and trim accordingly. Never trim evergreens to fantastic shapes, sometimes called "barbered trees." Cut out all dead or diseased limbs, and paint all wounds more than an inch across with pure lead and raw linseed oil or a mixture of carbolineum and asphaltum. Never use common paint. Stubs of branches always die and decay; always cut very close to trunk of tree in trimming. Many fine trees are ultimately ruined by ignorant or careless workmen who leave stubs when pruning.

No. 6. TREE SURGERY.

Secure a competent tree surgeon to treat decayed areas or cavities in valuable trees. Do not allow them to overcharge for work as representatives of a certain large company have done on various occasions. Ten to twenty dollars should secure considerable work on a medium to large tree unless it is in very bad condition. Charges in excess of this should be investigated. Cavities in trees must be chiseled out, sterilized and filled with cement level with the new bark growth. Never use metal covers for cavities. Split or cracked trees should be bolted or trussed with cable, never chains. Tile sunk about roots of weak trees aid in applying water and liquid fertilizer.

No. 7. BORERS IN SHADE TREES.

Certain beetles and other insects in adult or larval stages injure roots, trunks, branches and twigs of various trees. A coating of thick whitewash maintained from early spring acts as a repellent. Cut out and immediately burn all dying branches and all branches plainly infested with borers. Valuable trees may be treated by injecting carbon bisulfide into galleries of borers and plugging them with soft clay. Sanitation and prevention are better than curative methods. Peach tree borers must be dug out until we find a better control method.

No. 8. BANDING AND SANITATION.

Banding is not the "cure-all" that many people think. By this method a few wingless moths and some caterpillars are caught and prevented from ascending trees to destroy foliage. Cotton or sticky bands must be applied early in March for spring canker worm.

A plague of tussock moth caterpillars will occur in many localities in our State, unless the many egg masses are destroyed at once. Scrape or pull from trees all white frothy egg masses, or soak them with creosote on sponges fastened to poles.

No. 9. ARSENICAL SPRAYS.

Caterpillars, beetles and other chewing insects with biting mouth-parts attacking foliage are readily controlled by timely sprays of lead arsenate, using 2 or 3 lbs. to 50 gallons of water. One pound of Paris green and 2 lbs. fresh lime slacked in 50 gallons of water is an effective spray against these pests, but is washed off quickly by rain. Young caterpillars are easily poisoned,—hence spray as soon as injury is observed. Spray fruit trees with arsenate of lead combined with bordeaux mixture just after petals fall, again 2 weeks later, and again middle of July for clean fruit.

Full directions will be mailed free on application.

No. 10. OIL EMULSION SPRAYS.

Well prepared kerosene emulsion, and certain commercial soluble oils give good results when used properly, for sucking insects such as aphids or plant lice, psylla and scale insects. To make kerosene emulsion, dissolve $\frac{1}{2}$ lb. hard soap in 1 gal. boiling soft water, and add 2 gal. of kerosene. Agitate the mixture violently until a creamy white gelatinous jelly is formed when cold. Dilute with 8 to 10 parts of water before spraying foliage. For winter or dormant spraying dilute with 5 to 6 parts of water. Terrapin scale is controlled with only sprays, while ordinary lime-sulfur solution is not effective.

No. 11. NICOTINE OR TOBACCO SPRAYS.

The safest and best spray for soft bodied sucking insects on tender plants is some form of nicotine or tobacco solutions. Aphids on roses, sweet peas and similar delicate plants can be killed without plant injury. Commercial nictines are on the market everywhere. A tobacco decoction is made by steeping (not boiling) a pound of tobacco stems in 3 or 4 gallons of warm water in a closed vessel, for a few hours. Strain off liquid and spray on plants. Soap trolled with oily sprays, while ordinary lime-sulfur solution is not effective.

No. 12. PENNSYLVANIA GROWN TREES.

To furnish clean, disease free trees and other nursery stock for Pennsylvania buyers is the aim of our revised State inspection service. A most rigid and careful inspection, by well trained men will insure cleaner stock than has been grown heretofore in our State by more than two hundred nurseries.

A bill before our legislature if enacted will require licensing of all nursery agents in the State, thereby aiding us in detecting frauds and misrepresentation. Report nursery frauds to the Economic Zoologist, Harrisburg, Pa. We answer questions on pest control and beekeeping.

Fuller and more complete information on any of the subjects treated above will be gladly furnished, and in fact, information on the control or prevention of insect damage under any conditions will be available on application to the Economic Zoologist, Harrisburg, Pa.

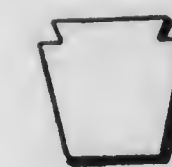
Approved June 4, 1917.

CHARLES E. PATTON,
Secretary of Agriculture.

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PENNSYLVANIA DEPARTMENT OF AGRICULTURE
BUREAU OF ECONOMIC ZOOLOGY

CIRCULAR No. 3
NEW SERIES



HARRISBURG, PA.,

JUNE 22, 1917

CROP PEST CONTROLS.

By J. G. SANDERS, Economic Zoologist.

The cost of government and administration of all state activities in the commonwealth of Pennsylvania could be readily financed by the amount of money lost each year through attacks of insects and plant diseases.

In the present national crisis, more particularly than in ordinary times, should everyone try to acquaint themselves with the control methods for these pests which have been determined by entomologists and plant pathologists engaged in these lines of endeavor.

The following series of "Crop Pest Letters" prepared by the writer for our daily papers, were originally printed in groups of six in the "Weekly Press Bulletin" of this Department, which is sent to the newspapers of the state free for their use. On request, fuller information on these topics may be secured free of cost. If possible send specimens of insects or pests with your request, addressed to the Economic Zoologist, Harrisburg, Pa.

No. 1. SAVE THE CROPS—DESTROY THE PESTS.

Five dollars for every man, woman and child in Pennsylvania is the average loss of crops in the State by insects and plant diseases. Upwards of forty million dollars is sacrificed annually to feed these pests, most of which are readily controlled by known remedies and measures properly applied. Ignorance of these control methods is costly.

A national effort to increase food production for America and the major portion of Europe is endorsed and urged by President Wilson and his cabinet. Needless sacrifices of crops to the many pests attacking them should not be permitted, when in many cases a little knowledge and foresight coupled with effort will reduce these losses.

A daily crop pest letter will be issued from the Economic Zoologist's office, briefly and opportunely discussing control methods for pests of agriculture, horticulture and public health. Additional information on any pests will be furnished freely and gladly on application to this office at the Department of Agriculture, State Capitol, Harrisburg.

No. 2. PESTS IN NEWLY PLOWED SOIL.

Much new and sod land will be plowed for crops this year. Several destructive insect pests including cutworms, white grubs and wireworms always found under these conditions, should be controlled if possible before planting crops.

Cutworms are brown smooth caterpillars which cut off young plants at the surface of the ground, often drawing them into holes in the ground. They feed at night doing much damage. The destructive "army worm" belongs to this group. Cutworms are caterpillars of the brown or gray moths or "millers" so common around lights in summer.

Poisoned bran mash is the surest control for cutworms. Mix thoroughly 1 pound Paris green in 20 pounds dry bran. Moisten with one quart cheap molasses added to chopped rind and the juice of 3 or 4 oranges, in enough water to make a dry mash barely holding together when squeezed in the hand. Scatter broadcast in the late evening over gardens or fields to be protected. This poison mash is also the best known grasshopper control, but for them must be scattered in the early morning. Birds will not eat this mash on account of the fruit juices. Allow chickens to forage in newly plowed land, for they destroy many forms of destructive insect life.

No. 3. WHITE GRUBS AND WIRE WORMS.

Great damage to potatoes, strawberries, corn and most other hilled crops is done by white grubs, the larval stage of the common brown June or May beetle, so generally attracted to lights during these months. White grubs naturally feed on roots of grasses, which are killed by plowing, thus driving the grubs to attack any planted crop. One grub to each square foot of grass might not be serious, but nine grubs attracted to each hill of corn planted 3 ft. each way will ruin the stand.

White grubs cannot be poisoned and no direct remedy is known, except chickens or birds following the plow and harrow. Hogs eagerly seek the grubs by rooting in the ground, and will frequently clean up a field satisfactorily.

Fall plowing and thorough disking of infested fields, or summer fallowing are effective preventive methods, against white grubs and wireworms. The capture and destruction of the May beetles by attracting them to lights suspended over tubs of water, with a heavy film of kerosene on the surface, has protected farms from infestation. The beetles are killed before they lay eggs in the ground. Do not confuse white grub, with cutworms.

No. 4. TREAT POTATOES BEFORE PLANTING.

Diseased seed potatoes used for planting will handicap your efforts for success with a crop. Common potato scab and "black leg" disease are carried on

seed potatoes. Treatment is so easy and so cheap that no excuse can be offered for carelessness. One pint of formalin or formaldehyde in 30 gallons of water, or one-fourth pound of corrosive sublimate (mercuric chloride—a severe poison) to the same amount of water, can be used in a barrel for soaking seed potatoes.

Before cutting soak the seed potatoes in one of the above solutions for two hours. Be careful that they are not re-infected by touching sacks or boxes which contained untreated potatoes. Plant soon after cutting, for delay and drying of seed cause poor setting of plants.

Planting of whole potatoes gives largest yield, but under present conditions hand cutting of seed into two or three pieces is recommended. Have ground mellow and in finest condition if small pieces are planted.

No. 5. POTATO SPRAYING.

The great Irish potato famines and heavy crop losses last year in America were caused by the "late blight" of potatoes. Several other diseases and insects which carry blight and attack foliage, stems and tubers can be controlled by well known sprays. It pays to spray. A Colorado potato beetle may deposit upwards of one thousand eggs during the summer over a long period. Two generations are common in this State. Foliage injury in plants is equivalent to reduction of lung capacity in animals, hence very detrimental. The tiny black jumping flea beetle attacks both leaves and tubers. The adult eats tiny holes in the foliage and carries the blight fungus, while the larvae burrow into the tubers.

Spray potato vines with Bordeaux mixture (3 lbs. bluestone or copper sulfate and 4 lbs. fresh lime in 50 gals. of water)—with 2 lbs. powdered arsenate of lead added. One-half pound Paris green may be substituted for arsenate of lead, but will be washed off by rain much quicker.

First spray when plants are 4 to 6 inches high, 2nd, two weeks later, and later sprays at intervals of 3 weeks. Four or five sprays thoroughly applied, with good nozzles, under heavy pressure, will insure a good clean crop, if seed has been disinfected.

No. 6. PLANT LICE OR APHIS.

Rose bushes, sweet peas, lettuce and other garden crops, as well as apple, plum and cherry trees are often severely attacked by plant lice or aphis which suck out the plant juices through tiny sharp beaks, and oftentimes carry blights and other diseases. These insects are sucking pests and hence cannot be killed by stomach poisons like Paris green. Contact sprays killing by touching their bodies are efficient. Tobacco or nicotine solutions are safest and best controls. Commercial nicotine solutions are on the market everywhere, to be used according to directions accompanying the package.

Homemade tobacco decoction is made by steeping (not boiling) 1 pound of tobacco stems in 3 or 4 gals. of water in a covered vessel for 2 or 3 hours. Squeeze and strain off the liquid and use as a spray. Soap suds added to the liquid acts as a sticker and spreader. Nicotine sprays when diluted properly will not injure the most delicate plant.

Powdered tobacco stems placed about roots of asters and chrysanthemums, etc., will kill root aphis so commonly destructive to these plants.

No. 7. WORMY AND SCABBY APPLES.

The apple worm or codling moth destroys every year one-half of Pennsylvania's apple crop. This loss reaches five million dollars. Why feed your apples to the worms, when a little care will obviate and overcome this great loss.

The commercial grower should spray five times a year, for perfect fruit, but four timely sprays, omitting the second, give excellent results in the average orchard.

First spray.—Dormant spray of strong lime-sulfur before buds open, for scale insects and aphis eggs.

Second.—When first blossom buds show pink, with Bordeaux mixture (3 lbs. bluestone, 4 lbs fresh lime in 50 gals. of water) and 1½ lbs. powdered arsenate of lead; or, for Bordeaux, substitute lime-sulfur solution, 1½ gals. to 50 gals. water.

Third.—With either of above combinations within 6 or 8 days after the petals have fallen.

Fourth.—Same solution about 10-14 days after third spray.

Fifth.—Same solution about third week of July, to kill second brood of codling moth.

Thorough and timely sprays as above will control most apple pests, both insect and disease. Be accurate and timely. More complete directions furnished on application.

No. 8. GNARLY AND DEFORMED APPLES.

Knotty, gnarly or deformed apples are caused by attacks of at least three types of insects. The apple worm is not responsible for such injury.

Curculios overwinter as adult, brown, roughened snout beetles, rarely seen by fruit growers. Emerging in early spring, they feed on buds, foliage and young fruit, cutting crescents in the latter for egg laying. These cuts never heal, and retard growth at that point, causing malformation. Sprays containing arsenate of lead as directed in Letter No. 7 generally control the pest.

Rosy apple aphid when abundant dwarfs apples by puncturing the small fruits to suck out their juices, and cause irregular pits and scars.

Apple red bugs cause damage in similar fashion, but produce evenly-rounded sharp pits in fruit. These and other sucking pests are best controlled by nicotine sprays or tobacco decoctions, combined with soap. Chemical companies, seed and drug stores handle prepared nictines. Add 2 pounds of common soap dissolved in each 50 gallons of diluted nicotine, as a sticker and spreader. Further directions on request.

No. 9. SPRAYING PEACHES AND PLUMS.

Brown rot, peach scab, scale insects and curculios cause heavy losses to peach and plum crops. They can be thoroughly controlled.

Apply dormant spray of strong lime-sulfur solution for San Jose scale and peach leaf curl. Terrapin scale is not satisfactorily controlled by lime-sulfur. Use with care diluted dormant spray of "Scalecide" or ten per cent. kerosene emulsion. Prevent oily sprays from running down tree trunk to collect at base, by placing a shovelful of earth around base to be removed later.

As described in Letter No. 7—the plum curculio eagerly attacks peaches and plums, cutting crescents for laying eggs, which develop into worms so commonly found in fruits. Arsenate of lead, 1½ lbs. powdered, to 50 gals. of weak Bordeaux mixture or lime-sulfur solution is the control.

Scab, brown rot and several other spotting diseases of the fruits are readily controlled by above spray. There is no known cure for "peach yellows." Cut out and burn infected trees.

1st—A strong dormant spray as above. 2d—Just as shucks fall from the fruits, use lead arsenate and very weak commercial lime-sulfur or self-bowed lime-sulfur. Continue sprays at intervals of about three weeks, depending on weather. Japanese plums have tender foliage like peaches and require dilute sprays. Cut out and burn all black knot. More definite instructions furnished on application. Borers are not controlled by sprays, but require special hand treatment.

No. 10. CHERRY PESTS.

Pennsylvania's most serious and insidious sour cherry pest is the "shot hole" fungus, causing early yellowing and falling of foliage (the "lungs" of the tree) which prevents setting of fruit spurs for the succeeding season. Rake up and burn or plow under old cherry and plum leaves on the ground. Brown

rot causes great fruit losses in moist, humid seasons. These and other fungous diseases are easily controlled by Bordeaux or lime-sulfur sprays, applied at proper time.

The curculio must be killed to prevent wormy fruit. Read spray control in letters No. 8 and 9. Black knot, also attacks cherry, and should be cut out and burned.

Black cherry aphid is controlled with nicotine sprays. Apply as soon as observed in numbers. Lady beetles prey on aphid and usually hold them in check, and do no damage, to foliage or fruits. They are the horticulturalists' best friends.

Cherries should be sprayed similarly to peaches and plums. San Jose scale does not injure sour cherry, but dormant lime-sulfur should be used to aid in control of fungous diseases. Spray just after blossoming, and repeat every two or three weeks, with arsenate of lead and a fungicide. Apply Bordeaux also immediately after picking crop.

Borers are not controlled by sprays. It is necessary to dig them out by hand. Cut off and burn all branches showing work of shot hole borers.

No. 11. CURRANT WORMS.

Currant and gooseberry bushes are generally attacked by green worms eating off foliage, thereby reducing the plants vitality and fruit crop. At least two broods appear each season, and two successive defoliations almost kill a plant.

Arsenate of lead sprays easily control these pests. Add Bordeaux mixture to prevent damage from leaf spot fungous diseases. Your currants and gooseberries should hold their leaves until frost were it not for diseases.

San Jose scale is a serious pest of currant, multiplying with great rapidity. Spray in early spring with strong lime-sulfur or oily washes.

Watch your gooseberry plants and currants for various mildews, aphid, borers and caterpillars and spray early. Arsenate of lead for chewing insects, and nicotine or tobacco decoction for aphid. Cut to the ground and burn at once all canes with borers. Sprays will not control them.

Currants respond quickly to fertilizers. No better jelly and marmalade is available than from these fruits. We answer questions.

No. 12. BERRY PESTS.

Many kinds of insects and plant diseases combat the berry grower's success but arsenical spray and fungicides applied early prevent damage. "Do it now" applies well in fruit growing.

Strawberries are attacked by leaf rollers, weevils, cutworms, white grubs and leaf spots. No remedy for white grubs but hand destruction. Plant only on soil cultivated the previous season and change locations of beds at least every three years. Leaf rollers, weevils and leaf spots are generally held in check by combined arsenate of lead and Bordeaux mixture applied once a week during early growing season. Kill cutworms with poisoned bran mash. Inspect new berry plants before setting for root aphid easily controlled by dipping roots in nicotine solution or strong tobacco decoction.

Spray raspberry and blackberry canes before foliage appears, and occasionally during season with arsenate of lead and Bordeaux, for insects and anthracnose fungous on canes, causing round dead spots, sometimes girdling and killing the canes.

Cut out to the ground and burn all canes with borers. No spray control. Cut off and burn raspberry cane tips dropping from maggot injury.

No. 13. PARIS GREEN vs. LEAD ARSENATE.

For the control of chewing insects in various stages, Paris green has been used for many years with varying success. Paris green is an aceto-arsenite of copper compound which is slightly soluble in water, and burns foliage unless its acidity is overcome by addition of lime to the spray solution. London

purple is a by-product of the dye industry, and varies in strength and solubility, so much as to make its value uncertain. We absolutely advise against its use as a spray.

Arsenate of lead is the safest, most satisfactory spray material yet compounded, having several advantages over Paris green and London purple. It adheres to foliage much longer during rainy seasons; it will not injure or burn foliage; it remains in suspension better, and being white aids the operator in thorough and complete application. Arsenate of lead may be purchased in dry powder or in paste form. The powder is not injured by freezing or drying out, and mixes readily with water. The paste form is one-half water, costing twice as much for freight or express charges.

Arsenate of lead is used $1\frac{1}{2}$ to 2 lbs. of powder to 50 gals. of water or Bordeaux mixture. Paris green, 1 lb. to 100 gals. water, must be used with Bordeaux mixture or with 2 or 3 lbs. of lime added to prevent foliage injury.

No. 14. BORDEAUX MIXTURE.

A combination of copper sulfate (bluestone) and lime was devised in France many years ago to control the destructive grape mildew and other fungous diseases of plants. Its use is general throughout the world, and its value is unquestioned. Many of the mildews, moulds, fruit rots, scabs, rusts, etc., are readily controlled by occasional applications; but it will not kill insects, although acting sometimes as a deterrent. A combination spray of Paris green or lead arsenate in Bordeaux mixture controls fungous diseases and biting insects.

Strong Bordeaux mixture is made by using the following formula; 4 lbs. copper sulfate, 4 lbs. of fresh lime and 50 gallons of water. A weaker solution is made by using a 3-4-50 solution, and a still weaker solution, for the spraying of grapes and other tender plants, by a 2-3-50 solution. Dissolve the copper sulfate separately in a wooden vessel, and slake the lime in another vessel. Each of these solutions should be diluted before mixing; otherwise undesirable chemical action results. Apply Bordeaux within twenty-four hours after mixing the two solutions, since it deteriorates quickly. Large growers often make up "stock" solutions of copper sulfate and lime to be mixed as needed. The separate solutions will not deteriorate.

When foliage is growing and expanding rapidly, it is advisable to make applications of Bordeaux at least every two weeks,—sometimes more frequently.

No. 15. KEROSENE EMULSION.

Kerosene emulsion is a valuable material for destroying insects which live on plants by sucking the juices through a tiny beak. It is, therefore, known as a "contact" insecticide, and made according to the following formula and directions:

Dissolve one-half pound of hard soap in one gallon of boiling soft (rain) water. When the soap is thoroughly dissolved, remove from fire and add two gallons of kerosene. Agitate this mixture violently by means of a force-pump, pumping the liquid back upon itself, until a thorough jelly-like emulsion is formed on cooling.

This emulsion is 66% oil, and must be diluted before spraying. For dormant application, 15% solution may be used, and can be prepared by adding three and one-half gallons of water to each gallon of stock solution. For spraying of plants in foliage, 7 to 10% is as strong as should be used. Seven per cent. is made by adding eight and one-half gallons of water to each gallon of stock solution, and 10% strength is made by adding five and one-half gallons of water to each gallon of stock solution.

Apply oil sprays on a clear, bright day, thereby reducing the danger of damage to foliage and plants generally. In using kerosene emulsion it is most important that a thorough emulsion—not a mixture—be produced, when preparing the stock solution. Otherwise oil will separate out, and may injure foliage sprayed.

No. 16. LIME-SULFUR SPRAYS.

Concentrated lime-sulfur solutions prepared commercially are nearly as cheap as home-made concentrate, except for large growers. For winter or dormant spraying dilute with 8 or 9 gallons of water to 1 gallon commercial concentrate. Summer foliage sprays must be much weaker, 40 gallons water to one gallon concentrate, to which one to two pounds dry arsenate of lead should be added for curculio, codling moth and caterpillars.

Home-made wash.—Place in a large kettle 20 pounds stone lime. Add boiling water, and stir in 15 pounds flowers of sulfur. Stir constantly, add 12 to 15 gallons hot water, and boil for at least 45 minutes. Add water to 50 gallon total; strain carefully and apply while hot for best results in dormant spraying.

Self-boiled lime-sulfur solution for peaches and plums.—Gradually add 3 or 4 gallons water to 20 pounds stone lime in a barrel. When slaking well, sift in 20 pounds fine sulfur; gradually add water, and stir constantly until a fine paste is formed. After about 10 minutes quickly add cold water to make 100 gallons of spray. Strain carefully, add 3 pounds dry arsenate of lead and apply for peach scab, leaf curl, blotch and curculio.

No. 17. DUST SPRAYS.

The application of insecticides and fungicides in dry form, known as dusting, is coming into general use to protect various crops. It can now be recommended for supplementary spraying in orchards, and for many truck crops is especially desirable. The small grower without a spray pump should dust his crops. Dusting is not effective for dormant spraying, but for summer application is helpful. Time saved by dust application methods is an important feature under present labor conditions.

Dry arsenate of lead combined with sulfur, with or without the addition of slaked lime, controls chewing insects and many fungous diseases. Forty acres of orchard treated by dusting in one day with large apparatus saves much labor when compared with 8 to 10 acres sprayed with liquid, although the cost of materials is somewhat greater.

Potato growers can use the sprays to advantage this season, saving many hours of labor. Ten to fifteen pounds of dry lead arsenate is mixed with 85 to 90 pounds of finely ground sulfur for best results. Certain small proportions of slaked lime may be used as a carrier.

No. 18. FUMIGATION METHODS.

Weevils are commonly found attacking peas, beans, wheat, corn and other grains. The Anguino grain moth attacking wheat, has caused a million dollars loss in Pennsylvania during the past year. Now is the time to clean out old bins and receptacles. Fumigate all infested seed wheat, and grind up or feed the remainder, before wheat heads out this summer to become infested.

Use carbon bisulfide, a colorless, ill-smelling, inflammable liquid,—one pound to each one hundred cubic feet, in tight bins or boxes. The liquid evaporates rapidly from open flat dishes, and the gas heavier than air sinks rapidly, and destroys insect life. Containers must be tight at bottom. Continue fumigation 36 to 48 hours.

Clothing, furs, feathers and silks to be laid away for summer should be thoroughly brushed and aired, then placed in a tight trunk or box, and fumigated as described above. Keep away all lights. Cereal foods may be safely fumigated in this way, and after airing, are fit for use.

Houses may be freed of certain insects and disease germs by, burning several pounds of sulfur in an iron container set in a box of sand or earth. Sulfur fumes will tarnish polished metal surfaces.

Formaldehyde is worthless for killing insects, although many people suppose it to be valuable.

No. 19. CUCUMBER AND MELON BEETLES.

The common yellow and black striped cucumber beetle causes more damage to cucurbitaceous plants than is generally believed. The adult beetles feed on and destroy the new leaves, a damage very apparent. But few people know that this beetle lays eggs about the plant from which develop tiny, white, thread-like larvae, which burrow, and tunnel in the stems, just at the surface of the ground. This injury often causes the sudden wilting and death of plants which were growing nicely.

Control this pest by spraying or dusting the plants frequently with powdered arsenate of lead, mixed with slaked lime or plaster of Paris. Be sure to treat thoroughly both sides of the leaves. Start controls as soon as new foliage appears.

For further protection place a handful of powdered tobacco stems immediately around the stems of the plants. Rain leaches out the nicotine, and kills the larvae in the stems.

No. 20. MELON APHIS.

Many crops of muskmelons and cucumbers have been partially or wholly ruined by tiny green aphids, sucking the plant juices from the underside of the foliage. Very rapid reproduction accounts for their sudden appearance in countless and destructive numbers. Watch your plants closely for first appearance of aphids, and treat immediately with great thoroughness.

Spray underside of foliage with nicotine solution, or strong tobacco decoction in soap suds. Follow up with weekly sprays, if necessary, until pest is under control.

For best spraying use a 3-4 foot spray rod, fitted with a good nozzle on a right-angled joint, to spray upward beneath leaves.

Greatest damage is done to young plants, hence early treatment is most important. Cabbage worms discussed to-morrow. Send us your questions.

No. 21. CABBAGE WORMS.

Cabbage plants do not naturally have perforated or ragged leaves, as some people think. The common green cabbage worm, the cabbage looper and the tiny caterpillar of the diamond-back moth cause the principal leaf damage. All are chewing larvae, and are readily poisoned with arsenicals.

Apply powdered lead arsenate, one part, to two or three parts of plaster Paris or slaked lime, with a duster, as soon as the earliest injury is noted.

There is no danger of poisoning the cabbage head for human consumption, unless it should crack open when about grown. Usually treatments are not needed after that time.

The common white or yellow butterflies seen about cabbage, cauliflower, etc., are the parents of our common green cabbage worms.

Watch your cabbage, cauliflower and radishes for cabbage aphis on under-surface of the leaves. Apply nicotine and soap solutions as for melon aphids.

No. 22. RED SPIDER OR MITES.

In dry seasons many garden and ornamental plants, and certain trees, are injured by "red spider" attacks, causing yellowing and dropping of foliage. Close examination reveals myriads of tiny reddish mites, partially protected by a fine meshwork of webby strands.

These creatures are not true insects, but are related to spiders, with more than the six legs which identify true insects. They remove the green coloring matter from the plant cells, and interfere with their functions.

Sulfur in dry form, or mixed in water, thoroughly applied is the sovereign remedy for "red spiders." A powder gun or blower, is the most satisfactory apparatus for treatment of infested plants. Several applications at weekly intervals during dry seasons may be necessary. Bean plants and phlox or "Sweet William" are usually injured by these little pests.

Fuller information gladly furnished on request.

No. 23. STRAWBERRY INSECTS.

Strawberry beds are automatically protected from much insect damage by replanting in new locations every second or third year.

White grubs, serious enemies of strawberry plants cannot be poisoned or killed by any poison application. Always set plants in ground that had been under thorough cultivation for two years, to avoid grubs and wireworms. Cutworms are easily controlled by poison bran mash described in an earlier letter.

Leaf rollers often damage foliage badly. Spray frequently as new spring foliage appears, with 2 pounds of dry arsenate of lead in 50 gallons of Bordeaux mixture.

Strawberry weevils attack and destroy the young unopened flower buds, causing them to droop and finally drop off. Apply powdered arsenate of lead and fine sulfur by dusting as buds develop. The sulfur dust application will aid in controlling leaf spot diseases, but Bordeaux mixture is more effective.

If root aphid is in your strawberry beds, dip plants for resetting in strong tobacco water for a few minutes, as a safeguard from transferring the pest to new plots.

No. 24. CROP PEST LETTERS REVIEWED.

No. 1.—Five dollars annual loss for every man, woman and child in Pennsylvania from crop pests.

No. 2.—Pests in newly plowed land.—Poison bran mash for cutworms and army worms.

No. 3.—No remedy for white grubs and wireworms. Thorough fall plowing and crop rotation best preventive.

No. 4.—Soak seed potatoes before cutting and planting, in one pint of formalin to thirty gallons water for two hours for scab and "black leg" control.

No. 5.—Spray potato vines with Bordeaux and lead arsenate for "bugs" and blight.

No. 6.—Nicotine or tobacco decoction sprays, best and safest for plant lice.

No. 7.—Arsenate of lead with Bordeaux or lime-sulfur properly applied insures clean, worm-free fruit.

No. 8.—Knotty, deformed apples and pears result from curculio damage. Arsenate of lead spray prevents loss.

No. 9.—Strong lime-sulfur dormant spray for scale and peach leaf curl. Self-boiled lime-sulfur and lead arsenate prevents wormy, scabby peaches.

No. 10.—Pennsylvania can produce wonderful cherry crops, if shot-hole leaf fungus is controlled by fungicides.

No. 11.—Feed arsenate of lead to worms on currant and gooseberry bushes.

No. 12.—Spray strawberry and cane fruits with lead arsenate and Bordeaux.

No. 13.—Four reasons why lead arsenate is preferable to Paris green for spraying.

No. 14.—How Bordeaux mixture is made by mixing blue vitriol (copper sulfate) and lime to control fungous diseases.

No. 15.—Directions for making kerosene emulsion, with proper dilutions for spraying.

No. 16.—Lime-sulfur spray solutions.—Commercial concentrated; home-made wash; and self-boiled wash for peaches.

- No. 17.—Dust sprays may replace certain summer liquid sprays; not good for winter sprays.
- No. 18.—Carbon bisulfide is best fumigant for insects attacking clothing, furs, feathers, beans, peas and cereal products.
- No. 19.—Arsenate of lead spray, or dry powder, for striped cucumber beetles.
- No. 20.—Melon crops often ruined by aphids. Use nicotine sprays.
- No. 21.—Cabbage worms succumb to powdered lead arsenate. No danger of poisoning the head.
- No. 22.—Powdered sulfur is sovereign remedy for red spider.
- No. 23.—Principal strawberry pests are controlled by repeated sprays of lead arsenate and Bordeaux.

No. 25. CODLING MOTH.

To grow perfect apples frequent and thorough spraying is an absolute necessity. The second spraying for the apple worms is as important as the first spray which was made when the petals dropped. Apply this second spray ten days or two weeks after the first spray and use lime-sulfur wash diluted 1 to 40 or Bordeaux mixture (3 pounds blue stone, 4 pounds fresh lime in 50 gallons of water) and $1\frac{1}{2}$ pounds of powdered arsenate of lead to each 50 gallons of spray material. The young larvae will soon be crawling and the poison applied now will kill them because they feed a little on the foliage before entering the apple.

In localities where the curculio has caused much gnarly, deformed fruit this spray is very important.

No. 26. ROSY APPLE APHID AND RED BUGS.

The rosy apple aphid lives on the leaves of the fruit spurs and when present in large numbers they so reduce the vitality of those leaves that they are not able to furnish sufficient nourishment to the fruits, which are dwarfed rendering them unmarketable.

In addition to the dormant spray given in Letter No. 7 which will largely control the aphids, a tobacco extract containing 40% nicotine sulphate should be added to the subsequent sprays for scab and codling moth. Use one-half pint in fifty gallons of spray material.

The red bugs are about the size of a grain of wheat and bright red in color. They are very active, and so are hard to find. They sting the fruit, and also injure the foliage on the young growth. They are present all over the State, and should be sprayed for as they are as serious a menace to perfect fruit as are the curculio and codling moth. To control add tobacco extract as directed for the rosy apple aphid.

No. 27. ANTS.

Ants are industrious workers, but they are so industrious that they become a nuisance for they will infest houses, particularly the pantries, hunting sweets. They are also to be seen climbing trees where they find aphids. The aphids secrete a honey dew on their abdomens of which the ants are especially fond.

There are ants which carry aphids to the roots of corn, others carry aphids to the roots of strawberry plants.

To control ants one must follow them and find the nests. Pour in each nest a little carbon bisulphide, and immediately cover the nests with damp cloths or clay to prevent the fumes from escaping. The fumes being heavier than air will sink to the bottommost portions of the ants' nest, smothering them.

For the corn and strawberry root aphids rotate the crops, and for those infesting trees use tobacco extract as given in Letter No. 26.

No. 28. MOLES.

When you find that your garden or lawn has been plowed by some subterranean animal who leaves ridges all about, you become aroused. The moles do this work. They are hunting for earth worms, and all kinds of larvae which infest soil, and so are really your aids because they help to get rid of insect pests. They do not eat vegetable matter, so that even the choicest bits of apple or potato that have been poisoned for them remain untouched.

The only way to catch them is by means of traps specially made for this purpose, and which can be purchased at hardware and agricultural supply stores. They are sometimes dug out, but as they are very sensitive to all vibration of moving objects overhead they retreat immediately when danger threatens, and so are seldom found. Fumigation of the burrows with carbon bisulfide is a possible control.

No. 29. CLUB ROOT OF CABBAGE AND RELATED CROPS.

There is a peculiar disease of the brassicas—cabbage, cauliflower, radishes, turnips, kale and other members of this family including such weeds as peppergrass. It is one of the slime moulds, and because of the peculiar shape of roots infected it is called Club Root.

There is no cure for plants infected. All that can be done is to adopt preventive measures, the best of which is to rotate crops. Never grow the same crop, nor allow one of the above crops to follow another of them on the same ground. Grow some other crops on that ground for several years.

Where the garden patch is small, and the use of the same ground for the brassicas is absolutely necessary year after year, the disease will be held in check by using lime. Apply about 1,000 pounds of fresh lime or 1,500 pounds of hydrated lime to the acre, and harrow it in thoroughly a week or two before setting the crop.

No. 30. ANTHRACNOSE OF BEANS.

It is an old adage that beans must not be worked when they are damp because it will spot them. The spot is caused by a fungous disease, and the working of the ground really has little to do with the spotting.

These spots are small, brownish or purplish discolorations at first, but they become larger, and the center turns dark and is sunken. Where several of these spots are close together they coalesce making one large irregular spot. Stems, leaves and fruit are infected, but it is the pods where most of the damage is done. Infected beans are unsightly, and while they can be used are of no use for market purposes.

To avoid trouble from the disease buy seed of varieties supposed to be free from it. If the seed is home-grown, select it from pods not infected. Then spray with Bordeaux mixture (5 pounds of blue stone, 5 pounds fresh lime in 50 gallons of water). When the weather is moist and humid make frequent sprayings (every seven to ten days), but in dry weather the intervals can be longer.

Rotating crops and burning all tops and other refuse will help greatly in avoiding trouble from this disease.

No. 31. THE HOUSE FLY.

A Disease Carrier.

The filthiest and most disgusting habits of any common insect are credited to the house fly. From filthy gutters and sewers to our tables and kitchens is too often a short, quick, unhindered flight. Several serious diseases of the human digestive tract are known to be carried by this common insect, such as typhoid fever, dysentery, cholera infantum, cholera; also tuberculosis, anthrax, tropical yaws (a serious skin eruption) ophthalmia and tropical sore.

House flies breed in manure piles and garbage. In summer the life history from egg to adult averages twelve days. A female fly lays one or more batches of about 120 eggs each—60 of which may become female flies to continue the cycle of several generations throughout the summer. Several millions may be the progeny of a single female. Controls and remedies are discussed in the next letter.

No. 32. THE HOUSE FLY.

A Disease Carrier.

The brief statement of habits in the previous letter is here concluded with relation to controls. Thorough screening of dwellings, shops, markets, dairies and food stands is most important. Unscreened food supplies are potentially dangerous. Many cities are criminally negligent in these important sanitary measures.

Eliminate collections of manure, garbage or decaying refuse. Keep manure in tight, dark boxes until it can be hauled away weekly to be scattered broadcast over fields to dry out. This is better than attempts to treat it with chemicals. Poison flies by mixing 1 part of formaldehyde with 5 to 8 parts of sweetened water or milk placed in an open dish with a piece of bread. Don't wait until the flies are in the house, but set this mixture (not poisonous to persons or animals) on shelves or porches or adjacent to outside doors. Formaldehyde as a fumigant for insects is useless.

No. 33. MOSQUITOES.

Several different species of mosquitoes are common in this State, including the spotted winged Anopheles which carries malarial fever. Their bites are uniformly annoying, altho some persons are more seriously infected. Only females bite. Some kinds of mosquitoes are quite domestic in habit and generally breed in water standing in tin cans, bottles or other containers about habitations. Others have little preference. Rain barrels, clogged eavespouts and gutters will often maintain an annoying supply throughout summer. In fact standing water under any circumstances offers a possible breeding place for the "wrigglers" which later change to adult mosquitoes.

Kerosene alone or mixed with equal parts of crude oil sprayed or poured on standing water forms a deadly film killing eggs, larvae and pupae of mosquitoes. Empty water from tin cans or bottles about dumps or spray with oil. Ditches and pools with standing water should be oil treated. Draining or filling of pools is most effective and permanent control of mosquito problems.

No. 34. ROACHES OR CROTON BUGS.

Warm weather favors the multiplication of roaches in houses, stores, bakeries, hotels and restaurants. These pests are readily carried about with barrels, boxes or packages from infested places. Milk cans returned from infested city places are frequent carriers of these pests to new areas.

There is no absolute remedy for these pests, excepting fumigation with cyanide gas which is too dangerous for use except by experienced persons. Numerous powders are on the market, some of which are of value, but many are useless. Sodium fluoride, which resembles fine salt, is the most effective material to be scattered or blown about the haunts of roaches and ants. Hot water is effective where usable. Gasoline injected into cracks and crevices is helpful but dangerous.

No. 35. CLOTHES MOTHS.

One million dollars annual loss in Pennsylvania from clothes moths is an extremely low estimate. In a population of eight million, but one in eight persons need experience a loss of a dollar to total this amount. Many suits and furs of large values are often ruined, so that our estimate must be low.

Thorough brushing and several hours exposure to sunlight and air is desirable before packing away for summer. Pack in tight trunk or box with cracks in sides and bottom sealed with gummed paper strips. Then fumigate for 36 to 48 hours with 2 or 3 ounces of carbon bisulphide. This liquid is inflammable and disagreeable in odor, and the vapor, much heavier than air, sinks to the bottom of containers driving out the air and kills all insect life. No damage to furs, feathers or fabrics. All woollens, including rugs, carpets and tapestries must be watched closely during summer.

No. 36. BUFFALO CARPET BEETLE.

Dark brown or black wooly larvae or "moths" are often found injuring carpets and rugs about baseboards or along cracks in floors. Upholstered furniture is occasionally attacked by them. Eternal vigilance is necessary if the housekeeper protects her house furnishings from damage. The parent of this wooly crawling larva is a tiny black and red checkered beetle often found in Spiraea blossoms feeding on pollen. Gaining access to houses often before screens are up, eggs are laid on woolen materials, generally in dark places, rarely in bright sunny rooms.

Apply gasoline to infested places in carpets and drench floor cracks and baseboards using precaution about fire by leaving windows open until fumes have disappeared. Carbon bisulfide fumigation as in previous letter is also successful in tight boxes or in very small closets if all cracks are stopped with strips of paper.

No. 37. CUT-WORMS.

Cut-worms are easily controlled, but ignorance of methods allow heavy losses of garden and field crops to continue, which aggregate throughout the State, hundreds of thousands of dollars, yearly. The army worm is one of the many species of cut-worms.

Cut-worms generally work at night, cutting off plants at the surface of the ground, and then they try to drag the plant into their burrows. These pests hide away during the day, and are not frequently seen except by close observation when cultivating the soil. Cut-worms must not be confused with the common white grub, which feeds only on the roots of plants and never appears above the ground. The common brown or gray moths which are attracted to lights at night during the summer, are the parents of cut-worms.

A poison bran mash made of common wheat bran, twenty-five pounds, mixed dry with one-half pound of Paris green, and moistened with three or four gallons of water, to which has been added the juice and pulp of three or four lemons or oranges, and one quart of cheap, black molasses. This poison mash should be thoroughly mixed with water so that it will barely hold together when pressed in the hand. Scatter this mash broadcast in the late evening through gardens or about fields which are to be protected from cut-worm attack.

To protect small garden plots, one quart of bran, one tablespoonful of Paris green, two or three tablespoonfuls of syrup and the juice of part of an orange with water will be sufficient.

No. 38. CABBAGE MAGGOTS.

The cabbage maggots which cause much injury to stems of young cabbage plants, recently set out, is the maggot of a common fly, which is similar in size and appearance to the house-fly. The fly lays its eggs at the base of the plant in the soil or on the plant itself, and these hatch in a very few days becoming tiny maggots which burrow into the stalks of the cabbage plants, causing much damage and frequently killing the plants.

Much of this damage of the maggots can be prevented by placing a small circle of tarred paper 4 inches in diameter about the plant. The little tarred paper disc, is cut half way through to the centre, and placed closely about the plant, and packed down on top of the soil. This will prevent, in most

cases the laying of the eggs by the adult fly, and injury from the maggots. This tarred paper disc treatment is available for garden plots, but is too expensive from the standpoint of time and labor to use in large field planting, although frequently results are satisfactory.

No. 39. ROSE-SLUGS.

Three species of rose slugs are found frequently at this time of the year attacking the foliage of rose bushes. One species skeletonizes the leaves, the second species eat holes in the leaves, and the third species eat large sections from the edge of the leaves. All of them, however, do considerable damage to ornamental rose bushes.

These slugs are the larvae of saw-flies, which lay their eggs in the foliage, early in the season, and quickly develop into the well-known slugs, doing various kinds of damage.

Arsenate of lead, either dry or mixed with water and sprayed on the foliage, will poison them quickly. Paris green may be used, but with less safety, on account of danger of burning the foliage. Either of these arsenical poisons, arsenate of lead or Paris green in powder form may be applied in combination with air-slaked lime or with dry flour as a carrier.

Apply bordeaux mixture or finely powdered sulphur for control of the rose mildew, and other rose-leaf blights.

No. 40. ASPARAGUS BEETLES.

Two species of asparagus beetles attack both the young shoots and the foliage of asparagus plants. The young shoots are injured and rendered unfit for use by holes bored into them by the adult beetles, and by the larvae. The tops are injured by the larvae and the plants are weakened, after the foliage is well eaten off. The twelve spotted asparagus beetle prefers to feed on the berries of the plant.

The larvae of these beetles look like small young potato beetle larvae, except that they are a leaden gray color. They are best controlled, by spraying with some arsenical poison, such as arsenate of lead or Paris green, preferably the former. Then as there are several generations each year of these two species it is well to attack them early, and apply poison to kill the first brood. Under certain conditions, the use of powdered arsenate of lead with finely slacked quick lime blown on the infested plant will accomplish good results.

No. 41. THE FLEA BEETLE.

Potato and tomato foliage frequently has the appearance of having been shot full of small holes. This is the work of the cucumber flea-beetle, which attacks potato, tomato, cucumber and the foliage of related plants.

The beetles are small, one-sixteenth inch long, black and very active and when disturbed, will jump and disappear. They eat holes in the foliage which injures it, reducing its ability to perform its proper functions, and in going from plant to plant they carry the early and late blight, thus spreading these two serious diseases. The control of the flea-beetle will prevent the spread of these diseases.

The larvae of the flea-beetle are small, slender worms that live in the soil and it is not uncommon for them to feed upon the potato tubers in the ground causing the tubers to develop "pimples" or raised spots.

Spraying with Bordeaux mixture to which arsenate of lead has been added, will prevent any damage from this insect. The Bordeaux mixture is an excellent repellent for them and the arsenate of lead will kill them if they eat foliage which has been covered with it. Further, the Bordeaux mixture is an excellent preventive of both early and late blight.

No. 42. PEACH SCAB.

The bluish-black smutty spots on peaches, are due to a fungous disease called peach scab. In serious infections the spots coalesce and the fruit cracks, making it unmarketable. Also the cracks are points of infection for brown rot.

The disease attacks the foliage and when this occurs the infected portion drops out, leaving an appearance similar to that left by the shot-hole fungus. The disease also is found in the young wood causing brown spots and from these spots the disease spreads the following spring.

Spraying with self-boiled lime sulphur wash, as for brown rot will control this disease. To make it, tip a barrel on edge put eight pounds of fresh lump lime in it, add enough water to almost cover it. Rub into a paste with a little water, eight pounds of sulphur. When the lime begins to slack add the sulphur and cook ten minutes, by the heat of the slacking lime, then dilute to fifty gallons with cold water to stop the cooking action.

Concentrated commercial lime sulphur can be used by diluting it to one part to 200 parts water. The ordinary sprays for brown rot holds the peach scab in check; apply two weeks after the shucks drop and another application one month before the fruit ripens.

Fuller and more complete information on any of the subjects treated above will be gladly furnished, and in fact, information on the control or prevention of insect damage under any condition will be available on application to the Economic Zoologist, Harrisburg, Pa.

Approved June 4, 1917.

CHARLES E. PATTON,
Secretary of Agriculture.

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NEW SERIES



HARRISBURG, PA.

SEPT. 15, 1917

CROP PEST CONTROLS. II.

By J. G. SANDERS, Economic Zoologist.

The following group of "Crop Pest Letters" completes the series that was prepared in this Bureau for the use of the Pennsylvania newspapers, during the crop growing season.

If judgment may be based on the many requests of citizens for fuller information on special pests, than was given in these letters, it may be assumed that the information put forth was graciously received and adopted.

The information given in these letters is very brief. It was necessary to condense them in this manner for newspaper service. The bureau will gladly send much fuller information on any of the subjects mentioned herein or upon related subjects upon application.

In order that the grower can fight the pests on his place intelligently he should know the life history of the pest so that it can be attacked during its most vulnerable time. We will gladly supply such information at any time.

If possible send specimens of the pest and the injury in a tight box with a description of the attack and extent of damage. Frequently an examination of injury reveals attacks of other pests than those suspected.

All inquiries and specimens should be addressed to the *Economic Zoologist, Department of Agriculture, Harrisburg, Pa.*

No. 43. PEACH LEAF CURL.

The peach leaves all over the state, where spraying has not been properly and timely applied, are curling up and making blister-like growths. This is caused by a fungus disease called peach leaf curl, which in bad attacks defoliates the trees. Once infected there is no control. Preventive measures only can be applied.

To prevent damage by this disease, spray the peach trees during the dormant season with lime sulphur wash, diluting the concentrated solution to test about 4 degrees Baumé, or 1.03 specific gravity.

The best time to apply is in the late fall or early winter while the weather is still warm enough to permit spraying. If delayed until spring it frequently happens that there is sufficient warm weather during the winter to start the buds to swelling. If this happens the bud scales are separated permitting infection of the leaves before they have emerged from the buds. Once infected no amount of spraying will control this disease.

No. 44. THE ROSE CHAFER.

Every rose grower is more or less bothered with the rose-bug or rose chafer. It also attacks cherries, grapes, peaches and many other fruits. It is more abundant in regions having sandy soil, than where heavy clays are present as the looser soil presents better breeding facilities.

To protect the plants, fruits and flowers from this pest, spray with sweetened arsenate of lead. Add to fifty gallons of water $2\frac{1}{2}$ lbs. of powdered arsenate of lead and two gallons of cheap molasses. It is absolutely essential that the spraying liquid be sweetened. If not sweetened the chafer will not eat it.

On grapes make an application just before they bloom and again after the bloom has fallen. If not protected, it is possible for the crop to be lost in a few hours by the insects eating the blossoms.

In the case of fruit crops, apply with the first appearance of the insects. In rose gardens start spraying when the rose chafer is due and keep the foliage covered with the sweetened spray. If you have only a few rose bushes or grapes to protect, use the arsenate of lead at the rate of two tablespoonfuls to a gallon of water and four tablespoonfuls of molasses.

Rose chafers do not breed in cultivated ground. If possible break up and cultivate for a season all uncultivated ground in the vicinity. It will greatly reduce the number of rose chafers.

No. 45. THE CABBAGE APHID.

Turnips, rutabages, cabbage, cauliflower and other members of the cabbage family, are attacked by a green aphid covered with a white powdery secretion. It is the cabbage aphid.

Last year turnip crops were seriously injured and in some cases lost, from damage from this insect. This loss could have been avoided by careful spraying at the proper time.

As soon as the aphids appear apply a tobacco extract containing 50% nicotine sulphate diluting one-half pint with fifty gallons of water. Add three pounds of soap to act as a spreader and sticker. Be sure to apply to the under side of the leaves which is best done by having a quarter turn on the rod just below the nozzle.

The aphids pass the winter in the egg stage on old cabbage stumps, etc., left in the fields. If such trash is gathered and destroyed immediately after the crop is gathered, and such weeds as wild mustard and shepherds purse not allowed to grow or remain on the land or near which cabbage is grown, much can be done to prevent damage from this pest.

No. 46. THE GRAPE BERRY MOTH AND ROOT WORM.

The Grape Berry Moth, and the Grape Root Worm can be controlled by thorough spraying with arsenate of lead and soap. Bordeaux mixture is added to this to prevent black rot and mildews from destroying the crop of fruit. Add three pounds of dry arsenate of lead and two pounds of dissolved soap to 50 gallons of 2-3-50 Bordeaux. Thoroughly apply just after the grapes bloom and again about 12 to 16 days later. This will kill the tiny berry worms shortly after they hatch and most of the beetles of the grape root worms before they deposit their eggs.

In some sections of Pennsylvania, where the season begins earlier and is longer, it may be necessary to make a third spraying in the fore part of August to prevent injury by the second brood of grape berry worms. Thorough work is neces-

sary and the spray can be applied best by using leads of hose and directing the spray nozzles by hand.

If the root worm beetles appear in number and eat their peculiar chain-like areas in the grape leaves without getting enough poison to kill themselves, a thorough spraying with three or four lbs. of arsenate of lead to fifty gallons of water, should be made immediately, covering the foliage entirely with spray and the root worm beetles will be destroyed.

No. 47. GRAIN BIN SANITATION.

Every year large quantities of stored grain are destroyed or rendered unfit for human food by some of the forty or more insects which are commonly known as weevils.

Much of this damage can be prevented by proper storage conditions, cleaning the bins, thoroughly fumigating them or spraying them with 10% kerosene emulsion. Destroy any weevil that might be present and be the cause of an infestation of the newly stored crop. Grain bins for storage should be well built and separate from the barn so they can be treated if the grain becomes infested and further, grain is not as liable to become infested with weevils when stored in a separate building. Inspect the grain every week or two and if the weevils are present, remove the grain, passing it out through a cleaner, if possible.

Weevils do not thrive in stored grain if it is moved and areated.

Preventing future trouble by thoroughly cleaning the empty bins and destroying possible weevil infestation by spraying with a 10% kerosene emulsion is as important as treating the grain after it becomes infested.

Stop the waste of stored grain through the lack of care and proper storage.

The prevention of one-half of the loss of 1% of 24,000,000 bushels of wheat and 54,000 bushels of corn rendered unfit for food each year after it is stored, is worth while considering. The average loss of stored grain on the farm is 1%. If the producers of Pennsylvania will practice clean methods and endeavor to lower the average loss one-half, it will mean a yearly saving of nearly three-quarters of a million dollars on wheat and corn alone.

No. 48. SQUASH BUGS.

Squash bugs are sturdy things, which are not affected by poisons and are almost immune to contact insecticides. If the young plants are watched carefully and the grayish bugs which are almost three-fourth of an inch long, are captured and killed, the future generation never becomes a serious pest. Collecting the orange colored egg clusters on the under side of the leaves and crushing them, is of material assistance, especially in the small areas of the average grower.

When the young squash bugs are present, spraying with kerosene emulsion, or better, 40% nicotine sulphate, diluting one part in 300 parts water and adding two pounds of soap to each 50 gallons of spraying material is an effective means of destroying them.

This spray must be applied when the bugs are small, or the bugs will scatter over the entire area planted in pumpkins, or squashes and control will be almost impossible. Destroying the old vines in the fall is also of assistance. The material should be piled up and left several days before burning in order to let hibernating individuals, seeking the protection offered by piles of old vines, have a chance to secrete themselves within its depths.

No. 49. CUTWORMS.

Reports of exceptional damage to young tomato, cabbage, cauliflower, pepper, potato and other plants throughout Pennsylvania and in other states are received almost every hour by letter or phone.

Do not mistake the fact that plants cut off at the surface of the ground have been attacked by cutworms. One may not see them, for they hide during the day in the soil or under rubbish. Don't blame the trouble on earthworms or slugs, as many persons are doing.

Cutworms are easily controlled with a simple remedy, and with one application at this time. Make a poison bran mash by mixing dry twenty-five pounds of bran with one-half pound of Paris green, moisten with 1 quart of cheap molasses, the juice and chopped pulp of 3 lemons or oranges, and sufficient water to make a dry mash, which barely holds together when squeezed in the hand. Smaller amounts in proportion. Scatter broadcast and sparsely in the evening, over gardens or fields to be protected. Birds will not eat the mash containing fruit juice.

No. 50. GRASSHOPPERS.

Everyone knows the grasshoppers' ability to destroy crops, when occurring in numbers. Few know how easily these pests are controlled by various means.

Uncultivated land is generally the breeding place of the common species, whence they fly to attack crops after reaching the winged stage.

The young wingless stages appear in early summer, and require several weeks to mature and develop wings. During this period control means are most successfully applied.

Scatter broadcast a poison bran mash exactly like that recommended for cutworms, along fence rows and roadsides in the early morning (in the evening for cutworms). Mix dry (25) pounds of bran with one-half pound of Paris green, or one pound of powdered arsenate of lead; moisten to a dry mash with one quart of cheap molasses, the juice and chopped pulp of three lemons or oranges and water. Mix thoroughly and apply by sunrise.

Chickens and turkeys eat grasshoppers greedily.

No. 51. STALK BORERS.

The stalks of many plants including tomato, potato, aster, dahlia, chrysanthemum and hollyhock are attacked by a smooth striped caterpillar which tunnels out the interior of stems, and often moves to other adjacent plants causing much damage. Wilting plants are warnings of injury.

Burdock, ragweed and other coarse stemmed weeds are native food plants, although the young borers feed for a time on tender leaves of various plants, before attacking stalks. The adult is a gray and white spotted moth.

Destroy all weeds near susceptible plants, or spray them with arsenate of lead. Clean cultivation is always advisable. Choice plants may be saved after attack by injecting with an ink dropper, three or four drops of carbon bisulphide in the burrows of the pest. Borers in squash vines should be cut out and killed. Draw moist earth over vines at several points to induce rooting to strengthen the plant.

No. 52. BLISTER BEETLES.

Sometimes large swarms of long, narrow, black gray or striped beetles appear and destroy the foliage of garden and field crops. Occasionally called "old-fashioned potato bugs," there are several species appearing in early summer, and each presents particular types of plants.

The young stages feed on the egg masses of grasshoppers in the soil, hence are beneficial for that time.

Quick action in spraying with arsenate of lead thoroughly applied may save crops; but their sudden appearance in swarms causes quick damage. Line of workers armed with foliage bushes can put them to flight with the wind and occasionally save a field crop.

No. 53. THE BAGWORM.

Peculiar conical bag-like cases of tough silken webs covered with leaf particles are often abundant on several kinds of trees and ornamental shrubs, and especially evergreens.

The bagworm overwinters in the egg stage in these bags formed the previous season by the female moth, which is wingless. After hatching the young larvae crawl to nearby foliage, and attack it greedily, grow rapidly and form the protective bag about themselves. These conspicuous bags remain over winter attached to trees.

Pick off the bags in winter or spring, and destroy them. If larvae have hatched and are at work, spray with arsenate of lead, using two pounds of the powder to each fifty gallons of water.

Careful picking is necessary to rid evergreen trees of the bags in winter, which is by far the best preventive.

No. 54. TUSsock MOTH.

Shade and ornamental trees are now suffering unusual damage from the tussock moth caterpillars. From the white egg masses, so conspicuous on the tree trunks during winter, have hatched myriads of tufted caterpillars, now making lacework of the foliage of linden, elm, willow, fruit tree and various shrubs.

Treatment of the egg masses in winter with creosote kills the eggs, and prevents summer damage to foliage.

Spray infested trees, especially the tender shoots near the trunk and larger limbs, with arsenate of lead, using two pounds of powder to each fifty gallons of water.

The female moths are wingless, and banding will aid somewhat, but is not completely effective. Many parasites and enemies aid in checking this pest, but treatment of egg masses and spraying of foliage is more certain. Do it now if injury is noted.

No. 55. DISEASES OF BEES.

In early summer colonies of bees sometimes grow rapidly weaker when they should be building up to harvest the honey flow. Some beekeepers erroneously blame this condition on spraying of fruit bloom, but usually diseases are present.

Two distinct brood diseases of bees—"European foulbrood" and "American foulbrood"—are prevalent in many of the counties of this State, causing heavy losses. Each disease has some distinct characteristics by which it is recognized.

European foulbrood develops most rapidly in the spring and early summer months, and is largely responsible for the beekeeper's belief that his bees are dying from spray poison.

This disease generally attacks the bee larva before it is sealed in the cell. The larva turns from the natural pearly white to yellow, gray or brown, and becomes a watery decayed mass, usually receding to the base of the cell. Odor may be lacking entirely, or sometimes resembles the odor of sour yeast. By introducing pure strain Italian race queens, usually resistant to this disease, the trouble usually ends.

American foulbrood is discussed in next letter.

No. 56. DISEASES OF BEES.

American foulbrood generally kills the young bee larva after sealing, at about the time it begins to pupate. The cappings turn from the natural glossy brown to a greasy appearance, and are sunken and perforated. The decayed larva becomes a brown, stringy and foul-smelling mass, stretched out on the lower cell wall. The odor is that of boiling glue and easily detected.

If treated before they become too weak, diseased colonies may be saved. Treatment consists of brushing the bees from their infected combs into a clean hive, where they can build a new set of combs. Requeening is desirable for successful treatment. Free instructions may be had from this office by letters. Bulletins may be obtained from this office or the Bureau of Publications, Department of Agriculture, Washington, D. C. All beekeepers who have diseased bees or are suspicious of disease, are urged to ask for aid.

No. 57. POTATO APHIS.

Many complaints of "green lice" on potato foliage have been received. When uncontrolled by spraying or by the tiny spotted lady bird beetles, these aphids multiply rapidly and curl and retard growth of the vines.

These pests suck out the juices of the plants through a tiny sharp beak, and cannot be controlled by arsenate of lead, pyrox or bordeaux mixture which kill or repel only chewing insects.

The nicotine sprays discussed in the next letter are most effective and safest to use without injury to the plants. Always apply spray materials by means of a spray pump and never by a common sprinkling can for it is wasteful of spray and does not cover foliage well.

No. 58. NICOTINE SPRAYS.

The safest and most effective sprays for plant lice or aphids affecting any kind of plants are commercial nicotine preparations or home made tobacco decoction.

The commercial preparations are highly concentrated and bear large dilution with water and soap. Black Leaf Forty, a 40% nicotine sulfate, kills aphids even though diluted with one thousand parts of water, with soap added as a sticker and spreader. Other commercial preparation of the same or less strength are good when directions are followed.

Make tobacco decoction by steeping (not boiling) a pound of tobacco stems in 3 or 4 gallons of water. Squeeze and strain off the liquid, add soap and use as spray.

No. 59. SCALE INSECTS.

Trees which are so badly affected with scale insects, that serious injury might ensue if treatment is delayed until fall or winter, may be treated with fair success in summer.

Watch closely for the appearance of the hatching young which look like tiny yellow mites, and immediately apply 6 to 8 per cent. kerosene emulsion or self-boiled lime-sulfur solution. Strong sprays cannot be used while foliage is present, except that strong lime-sulfur may be painted on the trunk and branches of small trees badly afflicted. Certain scale insects largely confine themselves to the trunk and branches of ornamental trees and shrubs.

No. 60. CHICKEN LICE AND MITES.

Poultry raisers must distinguish between lice and mites attacking their fowls. Control methods for lice do not affect the mites, and vice versa.

Mites attack chickens on roosts at night, then crawl into cracks and crevices during the day. Thorough spraying of poultry houses, roosts and nesting boxes with kerosene is most effective. Follow with whitewash and lime-sulfur application.

Chicken lice, different from mites, suck blood from the chickens and often harm young chickens seriously. A tiny bit of blue ointment mixed with equal parts of lard, should be applied to the chicken on the back of the head and near the vent.

No. 61. THE ARMY WORM.

The army worm sometimes appears in great numbers without warning, devouring crops of several kinds, especially oats and corn. Garden and truck crops usually suffer severely at such times. Since army worms appear without warning, be prepared for immediate control.

Army worms are a species of cutworms with a habit of traveling in great numbers from field to field seeking food. Two controls are available. Poison bran mash scattered before the moving hordes, or deep, straight-sided furrows turned toward the oncoming, crawling caterpillars. At intervals of 10 to 20 feet dig post holes in the furrow into which the worms drop, to be killed later by a light spray of kerosene.

Make poison bran mash by mixing 20 lbs. of bran, and $\frac{1}{2}$ lb. paris green, moisten and mix to a stiff mash with water, juice and pulp of three oranges or lemons, and one quart of cheap molasses. Broadcast thinly where needed.

No. 62. CORN EAR WORM.

Sweet corn and field corn ears are injured and fouled by a dark striped "worm" making them unfit for use, and causing much loss to growers. The parent moth of this smooth caterpillar lays its eggs on the silks of the corn, where on hatching, the tiny "worms" begin to feed and work their way into the developing ear.

Control is fairly simple, and consists of a dust application by blowing powdered arsenate of lead, three parts, and powdered sulfur, one part, on the corn as soon as the silks are showing fully. The corn silk is slightly sticky and holds the powder application very well. One application at the right time may be sufficient.

No. 63. THE APPLE WORM.

At least one-half of our apple crop is ruined each year by the apple worm or codling moth. The loss each year is at least three or four million dollars in Pennsylvania alone. Two broods occur each year. The second brood causes great damage to the half grown crops, while the first brood causes the heavy "June drop."

Apple trees should be sprayed with a combination of lime-sulfur, one and one-half gallons to fifty gallons of water, with one and one-half to two pounds of powdered lead arsenate added. Apply first spray four to eight days after the petals fall; second spray two weeks later; third spray, about last week of July or first week of August, in cooler parts of the State. These sprays will control foliage-eating pests as well. Dormant sprays of lime-sulfur for scale are necessary and advisable.

No. 64. HORSE BOT FLY.

Untold suffering, reduced efficiency and many deaths of horses are caused by attacks of horse bot flies. Few people realize how many horses are affected by these pests, which attach themselves as larvae or maggots to the inner wall of the stomach, where they remain for the greater part of a year. The stomach walls are often so thickly studded with the maggots, as large as a lead pencil in diameter, that digestion is seriously impaired.

The adult is a large tawny fly, which lays yellow eggs on the horses legs. These eggs are licked off by the horse, and quickly hatch, the tiny maggots attaching themselves finally to the stomach walls, and grow rapidly.

Control is easy. At least once a day rub down the horses legs with an oily cloth. Kerosene lightly applied is best, but too much may injure the hair.

No. 65. THE HORN FLY.

This imported pest is familiar to all stock raisers and cow owners, but few realize the great losses in milk products resulting from the constant annoyance and nervousness of the tortured cows.

The horn fly is smaller and darker in color than the biting stable fly, and it lies close among the hairs while feeding. Its habits of reproduction make it difficult to control its multiplication, but absolute cleanliness about a stable both inside and outside are helpful.

Cattle should be sprayed every day lightly with some one of the fly chaser compounds on the market. Keep the barn well screened, and brush off as many flies as possible, as cows are entering the stable. These little attentions will be repaid by increased production of milk and flesh.

No. 66. BITING STABLE FLY.

The house fly never bites for it has no puncturing mouth parts, altho many people declare that they have been bitten by house flies. The stable fly looks much like the house fly, and is often mistaken for it.

Horses, cattle, dogs and other domestic animals suffer greatly from this pest unless protection is afforded them.

Stables should be carefully screened and darkened during summer. Certain forms of easily applied fly traps can be placed in the windows of stables, where thousands of these pests may be captured and destroyed. Full instructions can be secured on application to the Economic Zoologist, Harrisburg, Pa. Cleanliness and sanitation are valuable controls for all such pests. Use fly nets liberally on work horses in the fields.

No. 67. POTATO APHIS.

Great damage to the new tip leaves by green lice or aphid on potato vines is now observed by growers in many parts of Pennsylvania. Numerous letters and telephone calls for immediate aid have been received in this office.

These lice multiply rapidly, and appear to come in from outside sources, but really have developed from a few unnoticed adults.

Arsenate of lead, paris green and Bordeaux mixture are useless, because the lice puncture the plant with a tiny beak, and suck out the sap. Spray with nicotine solutions or tobacco decoctions mixed with water and soap, according to directions. Don't use a sprinkling can, for material is wasted and treatment is not effective. Buy a sprayer to suit your needs for it is money wisely invested for treatment of many kinds of crops.

No. 68. APPLE MAGGOT.

White footless maggots, which burrow and mine the flesh of certain varieties of apples, are serious pests in several northeastern states, including the northern part of Pennsylvania.

A fly with black banded wings punctures the apple, and lays eggs in the pulp. Soon the developing maggots ruin the fruit for human food. Summer and autumn sweet or sub-acid varieties are attacked most seriously. One generation a year is produced. The adults appear in July and August, and suck up stray liquids and juices for a number of days before laying eggs.

Control by lightly spraying the trees with arsenate of lead and water, at weekly intervals. Scattered, coarse drops of the spray are sufficient. The usual second brood codling moth spray, about August first, is also helpful.

No. 69. TOMATO PESTS.

Tomatoes have numerous enemies among insects and diseases. Caterpillars, flea beetles, aphids, white fly, mildews and rot are common, but are readily controlled by common sprays applied every week or two.

Bordeaux mixture, with nicotine added, controls rots, mildews, white fly and aphids. Arsenate of lead kills caterpillars, flea beetles, blister beetles and other chewing insects.

The greatest losses to tomato crops are caused by different kinds of rots. Prevent the tomato fruits from touching the ground, and spray frequently with bordeaux mixture.

Stalk borers must be cut out with a small bladed knife. Clean cultivation and freedom from weeds is most helpful.

No. 70. ONION THRIPS.

Where onion tops are growing nicely they are often attacked by a tiny yellow thrip, causing a whitening or blasting of the leaves. Thrips suck the green chlorophyll from the plants, and prevent growth and development of the onion bulb. Look for them at base of leaves or in protecting folds.

Spray with nicotine solution combined with soap as a spreader and sticker. Apply spray with as much pressure as possible for effective work.

Clean cultivation is advisable, for thrips over winter on weeds and grass adjacent to fields. Crop rotation is always recommended as an aid to insect control. In the early season watch for first appearance, and control at once.

No. 71. CHERRY LEAF DISEASE.

One-half of Pennsylvania's sour cherry crop is lost each year, because of a leaf disease commonly known as "shot-hole fungus," which causes premature yellowing and dropping of foliage, so necessary to development of fruit buds for the next year.

Few growers appreciate the absolute necessity of holding foliage on fruit trees to furnish the sugars and starches, so important in tree growth and production of fruit.

Spray cherry trees at once after picking the fruit, with bordeaux mixture, 3-4-50 formula, or with self-boiled lime-sulfur solution. Plum trees should be sprayed in similar manner. Fuller instructions on request.

No. 72. BROWN ROT.

Thousands of bushels of plums start to decay or rot on the tree just previous to ripening, and many growers cannot account for this condition.

A distinct disease known as "brown rot" is carried over from year to year by the old mummied fruit on the tree or ground. Warm rains develop the sores which infect fruits, particularly in breaks in the skin. Insects can carry the spores when puncturing fruits. Most tree fruits are affected.

Bordeaux mixture, or self-boiled lime-sulfur should be applied several times during the growing season, and strong lime-sulfur in early spring, when trees are dormant.

No. 73. FLOUR MILL INSECTS.

Heat or high temperature kills all stages of the Mediterranean flour moth and other insects infesting flour mills. By equipping the mill with a steam heating system, adequate for heating the mill in winter to 60 degrees F., the mill can be heated to 130 degrees F., if the steam is turned on for 24 or 36 hours on a warm day of June and September. This temperature should be maintained for four or five hours, in order to heat through every machine in the mill.

The cost after the heating system is installed is low; the heat method is safe, and is the most effective method known. For complete information and estimates of the amount of radiation required in your flour mill, write to the Bureau of Economic Zoology of the Department of Agriculture of Pennsylvania, Harrisburg, Pa. Insure better and cleaner food products to all consumers by doing your part.

No. 74. PROVIDE BETTER STORAGE FOR GRAIN.

More than one per cent. of the 24,000,000 bu. of wheat and 54,000,000 bu. of corn, the average crops of grain in Pennsylvania, is rendered unfit for food by some of the various insect pests, which attack the grain in storage, or the products made from it.

Most of the injury can be prevented by providing adequate sanitary storage rooms, and by careful inspection every week.

Grain should be stored in a building especially provided for the purpose, well ventilated, roomy and permitting the shifting of the grain, or other means of aeration.

Rats and mice can be excluded readily when a building is provided only for grain storage, and this means the saving of grain whose value cannot be estimated.

Separate granaries or buildings can be readily cleaned, fumigated or treated. The grain stored in them is less liable to become infested by insect pests, especially when these buildings are situated some distance from the barns.

No. 75. PLUM CURCULIO.

Much of the spread of brown rot on peaches and plums is due to wounds made by the plum curculio, when feeding or making punctures in which to lay its eggs. Dry or powdered arsenate of lead, 1 pound to 50 gallons, with 1 pound of dissolved soap, may be combined with bordeaux mixture, and sprayed on the trees, thoroughly covering every plum with a coating of poison, will completely rid the plum, peach and cherries of this pest.

Spray the fruit early in the season just when the small fruits are pushing off the shucks, and again about a week later. The arsenate of lead spray, combined with the soap as a sticker and spreader, poisons the beetles when they feed.

Curculio injury to apples in August and September may be prevented by coating the fruit with poisoned spray, and the brood of beetles almost destroyed before they seek winter hibernating quarters. This means less trouble next year. Look ahead not back.

No. 76. THE LESSER APPLE WORM.

The lesser apple worm attacks the young apples in much the same way as the codlin moth. The worms and moth are smaller, however. In the worm state they feed just under the skin of the apple, making an unsightly blotch on the surface of the apple. Many of the first brood worms pupate in the fruit, not migrating to the trunk of the tree to complete their transformations under pieces of rough bark, as do the over-wintering ones.

Thorough spraying for codlin moth control will usually control the lesser apple worm. A thorough coating of poisonous spray over the entire surface of the apple is necessary. Spraying from only one side of the tree will not cover the fruit with a coating of poison. Spray from all sides, if you expect to get results.

No. 77. BLISTER BEETLES.

Potatoes and garden crops are sometimes attacked by the old-fashioned potato bug, long, black or gray or striped beetles with enormous appetites. They are members of a group of beetles called blister beetles, and in their worm or larval stage they live almost entirely on grasshopper eggs. In the potato field disturbing the beetles by spraying, or some other method, will often cause them to seek new feeding quarters, and some can be killed by spraying the potatoes heavily with arsenate of lead.

Occasionally large numbers can be killed by driving over the migrating army—driving over the length of the column several times with a hand roller. Any method of disturbing them will usually make them leave.

No. 78. KILL THE APHIDS.

Plant lice on potatoes and tomatoes will seriously injure the crop unless prompt control measures are taken.

Spray the plants especially on the underside of the leaves with Black Leaf 40, one part in 600 of water, and add enough dissolved soap to make the spray spread and cling to the plants. Many leaf hoppers and other sucking insects will be destroyed by a thorough spraying with this mixture. Spray thoroughly, as a little extra spray solution is not wasted, and often it is the means of securing an effective control.

Fuller and more complete information on any of the subjects treated above will be gladly furnished, and in fact, information on the control and prevention of insect damage under any condition will be available on application to the Economic Zoologist, Harrisburg, Pa.

Approved Sept. 1, 1917.

CHARLES E. PATTON,
Secretary of Agriculture.



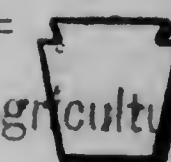
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HARRISBURG, PA.,

AUGUST 25, 1917

OFFICIAL QUARANTINE NOTICE.

Prohibiting of Shipment of Christmas Trees and Greenery from
certain portions of New England into Pennsylvania.

An extremely dangerous and destructive pest known as the Gipsy Moth (*Porthetria dispar* (L)), originally imported from Europe, has become established throughout considerable portions of New England, and is causing much damage.

In spite of an expenditure of more than \$14,000,000 of state and government monies for control and eradication work, this pest has continued to spread to new areas. The introduction and establishment of this pest in Pennsylvania is possible by means of egg masses on various evergreen trees cut in the infested districts of New England and transported for Christmas decoration.

Since this dangerous pest is not known to exist in the Commonwealth of Pennsylvania, and believing it important and necessary to protect the horticultural interests from invasion, this department promulgates the following quarantine against certain plant shipments from portions of New England.

QUARANTINE.

By virtue of authority conferred by an act of Legislature approved June 29, 1917, The Pennsylvania Department of Agriculture hereby prohibits the shipment, transportation, acceptance, receipt or sale or other disposal in the Commonwealth of Pennsylvania of any coniferous (evergreen) trees, such as spruce, arbor vitæ (white cedar), fir, hemlock, or pine, known and described as "Christmas trees," and parts thereof, and also decorative plants, such as holly and laurel, known and described as "Christmas greens or greenery," which were cut or originated in the gipsy moth quarantine area as bounded, maintained and described by the Federal Horticultural Board.

It is further ordered (1) that any plant materials described above received in this State from the above quarantined area, shall be destroyed as a public nuisance. (2) In case of doubt in regard to the origin of any such prohibited plant material, the burden of proof shall be upon the owner or shipper.

J. G. SANDERS,
Economic Zoologist.

Approved August 15, 1917.

CHARLES E. PATTON,
Secretary of Agriculture.

END OF YEAR